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ABSTRACT

Learning is defined as the modification and acquisition of knowledge, feelings, and abilities of the student--the outcomes of the teaching-learning process. The teaching-learning process in vocational education is intended to serve as the vehicle for achieving specific outcomes embodied in the goals of the vocational program. Two primary strands of learning theory have had significant influence on educational organization and development. Behavioral theories emphasize change in behavior. Cognitive theories emphasize changes in the content or structure of an individual's memory. To apply these theories of learning to vocational education, the teacher must be able to translate them into the context of vocational education. Claims have been made that the vocational curriculum differs in significant positive ways from the academic and general curricula. Vocational education focuses upon work-related skills and values and, its proponents claim, its methodology and content motivate students to learn. Researchers have also identified characteristics of the vocational classroom that provide conditions conducive to learning and motivation for learning. A challenge for vocational educators is teaching skills needed for the future. A needed emphasis is on teaching thinking skills for purposes of continued learning and applications in problem solving and decision making. (YLB)

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APPROACHES TO LEARNING WITHIN THE VOCATIONAL EDUCATION CONTEXT

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PREFACE

As we move toward establishing a collaborative research effort between our nations it will be important to study both the work done in our countries and the work conducted in other nations. On any topic of macro concern and interest there must be an incredible amount of information in the world. Compiling this information in a usable form and then disseminating the information may well be the challenge of the twenty-first century for the education and training enterprise.

The papers put forward at this first joint USSR-USA seminar begin this process. May we continue not only for the science of education and training but also for the world.

INTRODUCTION

The process of learning in vocational education involves the student in an interaction with the environment. Learning itself is under the control of the student, but teaching and many of the elements of the learning environment can be controlled by the teacher. The success of each depends on the other. The student's environment frequently, but not always, involves such factors as classroom, laboratory, teacher, and/or instructional support materials. This interaction can be an exciting multi-sensory experience that involves many people and support materials, or it may be a simple experience of reading a few pages in a textbook. An infinite number of options are possible for the creation of a teaching-learning environment to assist the student in the learning process.

In vocational education, in addition to the typical classroom, the teaching-learning environment is likely to include an equipped laboratory that simulates some aspects of a work setting. In this setting, the desired learning outcomes can be approached naturally through hands-on activities, applied examples, or demonstrations. Yet the ultimate intent of the process is identical to that of other types of education--to assist the student in learning.

What is Learning?

"Learning is a relatively permanent change in a person's knowledge or behavior due to experience." (Mitzel 1982) This definition encompasses all types of learning.

Learning occurs both within and outside the school, and teachers are concerned about the entirety of their students' learning. However, for purposes of this chapter, the definition of learning can be narrowed a bit to mean the acquisition of knowledge, feelings and skills brought about by the instructional presentation of the course content. In this context the focus is upon the modification and acquisition of knowledge, feelings and abilities of the student, the outcomes of the teaching-learning process.

The Teaching-Learning Process in Vocational Education

The teaching-learning process in vocational education is intended to serve as the vehicle for achieving specific outcomes that are embodied in the goals of the vocational program. Overall, vocational programs are expected to provide students with--

- training in specific job skills consistent with employers' needs
- education in basic academic skills such as communications, mathematics, and science at levels that will enable them to perform job tasks effectively, and to adapt to changes on the job, and to undertake further education and training
- development of habits and motivation needed for successful and expanding job performance, responsible participation as citizens and consumers, and for the pursuit of further education and training.

The challenge for vocational educators is to ensure that the needed competencies are reflected in a systematic way in the curriculum and instruction that students experience. Teachers

need to examine the content of their courses to assure that students are given an opportunity to both learn and use those competencies. Further, those competencies should be specified with the desired standards and levels of learning, and these levels and standards should be reflected in the tests or assessments given students. Consistent alignment of objectives, instruction, practice, and assessment is an important component of the teaching-learning process and an important instrument for achieving the desired learning outcomes.

The discussion of the teaching-learning process in this paper will begin with an overview of learning theories. As instructors become involved in creating their programs, it is imperative that they be able to apply knowledge of the process of learning and also have a firm foundation of concepts upon which the processes were conceived. The study of learning and learning theories encompasses volumes of literature and research and is the subject of years of study by educational psychologists and others. This paper will highlight some of the thinking about learning and suggest how it has been applied in vocational education.

To best understand how to apply the theories of learning to vocational education, it is necessary to learn about these theories and then translate them into the context of vocational education. In this paper, that translation is introduced through a discussion of claims made for the outcomes of vocational education. These are further explored by identifying the characteristics of the vocational classroom that provide conditions conducive to learning and motivation for learning.

APPROACHES TO ANALYZING LEARNING

Overview of Theories of Learning

Developing an understanding of how and when to use knowledge about learning and the teaching/learning process are two of the most important ways in which a person can prepare to teach. It is reasonable to expect teachers--like doctors or lawyers--to have a basic understanding of the theoretical and conceptual basis for the knowledge, skills and attitudes of their profession.

Just as one would not expect a simple explanation of how an architect begins with an idea and progresses through the design of the structure to the detailed working drawings of a new building or how a physician diagnoses an illness and proceeds with treatment, neither should one expect a simple explanation of how a teacher addresses the process of learning. The teaching profession requires the teacher to have command of many mental, emotional, and physical tools. Basic among these tools are the theories of how people learn. No one theory of learning fits all learning situations, just as no one way exists to design a building or treat a patient.

Behavioral and Cognitive Theories of Learning

Two primary strands of learning theory have had significant influence on educational organization and development in the twentieth century. The behavioral theories of learning emphasize, as the name implies, change in behavior. Behavioral theories focus upon what the learner does and how the behavior of the learner is affected by some experience. Cognitive theories of

learning, on the other hand, emphasize changes in the content or structure of an individual's memory. Cognitive theories focus upon what a learner knows as opposed to what the learner does.

Theories about Behavior

Behavioral theories dominated the study of learning from the late 1800s until the early 1960s. The research of two individuals stand out as central behaviorist work. Both E.L. Thorndike's and B.F. Skinner's work have significant influence on what happens in the classroom today.

Thorndike analyzed behavior into small units. He then explained learning as a process of combining these units to form a complex behavior. He believed that all behavior could be understood as a welding or fusion of the small units. As explained by Pillinger and Gooding (1971), Thorndike described the basic learning pattern as a mechanistic response to external forces (such as rewards). A stimulus evokes a response. If that response is rewarded, it is learned. This is indicated by the fact that if the stimulus is presented again, the rewarded response is more likely to occur than any other.

Some of Thorndike's working ideas were accepted as a beginning point for the work of B.F. Skinner. Skinner agreed that complex behavior is really simple behaviors occurring in combination. Skinner agreed that learned behavior is a type of mechanical response to external forces. However, Skinner did not accept

the significance of the original stimulus. He maintained that any response is more likely to reoccur if it is immediately reinforced. Reinforcers have much the same role for Skinner as rewards do for Thorndike.

Skinner disagreed with Thorndike on the importance of the management of stimuli that precede a response. His emphasis is more upon managing the reinforcers that occur with or after a response.

Teachers who choose to implement a Thorndikian approach will teach differently than teachers who choose a Skinnerian approach. One approach embodies different teacher behavior than the other; however, similar results can be gained by either. As a matter of sound practice, teachers can, and perhaps should, choose to implement both approaches as they design their course of instruction.

Theories about Cognition

Although much is known about the learning process that enables educators to be helpful to learners, nevertheless "the construction of a fully satisfactory theory of learning is likely to remain for a long time an uncompleted task." (Hilgard & Bower 1966, pp. 13-14). One of the difficulties is that what is learned for one set of learners in one environment studying one topic at one level is not immediately generalizable to all learners, all environments, all topics, and at all levels. However, researchers seem to agree that people do not all learn in the same way; this concept has been the basis of a great deal of recent work by cognitive psychologists. The later discussion of differences in

learners and their learning styles has importance because of this. Indeed, the existence of individual differences in learning might seem obvious, and therefore trivial to mention, were it not for the fact that even today much of what goes on behind classroom doors seems to spring from an opposite premise. A look into the vast majority of today's classrooms would show large groups of students being lectured to and expected to progress in lockstep fashion with little to no focus upon them as individual learners.

Over the last twenty-five years a great deal has been revealed by the research of cognitive scientists who are studying the nature of learning for people both in and out of school. While these findings are not definitive and must be applied with caution, they are encouraging for educators working on an applications approach to learning and struggling to make learning more accessible to the educationally disadvantaged, many of whom are enrolled in vocational programs.

In reviewing the cognitive research in educational psychology over the last quarter century, Glaser and Bassok (1989) identify three foci:

- analyses of competence--establishing the difference between beginners and experts and using that information to build models reflecting the conditions of learning and organization of material that might help move beginners toward mastery
- the role of prior knowledge and skills--recognizing that learning may be more importantly tied to the learner's constructs for receiving instruction than simply a matter of the content the instructor covers
- the process by which learners apply knowledge and skills--investigating the interplay of learning with the contexts of work and life for problem solving

Piaget is classic among those who have studied cognitive development. Piaget's theory identifies four stages of intellectual development for children: early sensorimotor, preoperational, concrete operation, and formal operations. These stages represent increasingly complex capabilities and intellectual skills. Thus, at some point, adolescents tend to be able to move away from the earlier purely concrete orientation to more formal abstract thinking. An important contribution of the work of R.M. Gagne is consideration of the learning conditions that need to be established before systematically designed instruction can yield the desired learning outcomes (Gagne and Briggs 1974). The performance, or desired learning outcome, is, he suggested, influenced by both conditions internal to the learner (such as recall from memory) and conditions external to the learner (such as repetitions of practice problems that may be assigned).

An important lesson that has been fruitfully researched by a number of cognitive psychologists is that new information must be linked or "hooked" to prior or existing knowledge. One can picture a framework or scaffolding in the mind with pieces in place. New pieces must hook up with those already there and begin to form a coherent integrated set of pieces or otherwise fall out of the framework altogether. The message is that teachers must use the knowledge that students already have to build new knowledge. The implication is that the usual one way (top-down) approach of an expert instructor dispensing course content to the learner in some simplified form is unlikely to be effective. Instead, eliciting

from students a review of what is known, with allowances for differences among students, would help to lay the foundation for moving to new content and showing how the new content relates to the foundation. This approach allows for two-way learning interaction.

A potential pitfall exists when the prior "knowledge" is wrong or deviates from accepted ideas. This can happen from misconception of previous instruction. In addition, it can happen because people form knowledge unaided from their own experiences. As summarized by Raizen (1989),

> "It appears that what people know through experience exerts a powerful influence on what they learn in the classroom. When this intuitive `knowledge' runs counter to the canonical knowledge held by experts in the field, it poses a considerable barrier to relearning or new learning...In this kind of situation, restructuring people's naive conceptions to accommodate more sophisticated and powerful concepts requires their exposure to repeated and various experientially based counter-examples that will lead them to question and finally reformulate their own notions to fit better with the new evidence."

A second important lesson relates to the extent to which traditional school learning is congruent with learning needed for work. In fact, research indicates that people tend to learn differently on the job than they do in traditional school settings and that they use what they learn differently (Resnick 1987). The presumption is that learning that is related to the context for its use will enable students to use the learning effectively on the job. Although this point bears further research, it also corresponds to the idea that applied learning is likely to be more motivating for students because the function of the learning is

made apparent. This is termed "functional context instruction" by Thomas Sticht (1987).

The implication is that teachers should attempt to simulate the work situation as closely as possible in their instruction so that students understand why they are learning these concepts and skills. Then they can translate to how these skills will be applied in the real world. Active application of these skills implies the use of learning activities that replicate, so far as possible, the workplace situation. For example, learners should read job-related manuals, charts, and tables to get information to organize a plan of action to complete a job task. Learners should be exposed to actual workplace written communications and should practice writing clear messages as if they were going to inform co-workers.

Identifying important information is a critical skill for reading and writing in any occupation; only the content changes from one vocational area to another. While an auto mechanic works with car part manuals and written repair estimates and a food service employee works with institutional cookbooks and food orders, both use reading and writing skills.

Further, students should have the opportunity to practice applying the learning themselves in a realistic situation. Herein lies a strength of the vocational laboratory, which provides at least a semblance of the real-world environment and incorporates the tasks, materials, and tools of the real-world situation for practice.

Conclusion

Although behavioral and cognitive theories of learning have been discussed separately, it should be noted that researchers working with either behavioral or cognitive theories have benefitted from and incorporated ideas from the other, so that these strands are not totally distinct from each other. Further, many other experts have studied the learning process for many years. They have created numerous theories of how people learn and have published numerous articles and books on the topic. Researchers have devoted their careers to the study of learning and the learning process. The body of scholarly and practical information about learning is vast and far beyond the scope of this text. However, it is critical that those preparing to teach become familiar with a system designed to classify instructional objectives. This major classification system has been relied on heavily in instructional design for vocational education programs. The next section discusses this classification system.

Learning Domain Classification

The basis for much of the learning that occurs during a course of study is a direct result of the motivation and planning of the instructor. Much of a teacher's planning is a direct outcome of his or her own personal learning experience. These outcomes are frequently stated in the instructor's lesson plan in terms of some anticipated demonstrable student behavioral change. These statements or lesson objectives are frequently written and shared with the students so that they know what their teachers expect as outcomes of the instruction.

Some of the finest educational scholars of the twentieth century have developed systems to educationally, logically, and psychologically classify educational objectives. These classifications or taxonomies were anticipated to be helpful to educators who deal with curricular and evaluation concerns. Their primary purpose was to enhance communication. It was especially intended to assist these people by empowering them to discuss the challenges of teaching, learning, research, and evaluation with greater precision.

Learning Domains

Three learning domains; cognitive, affective, and psychomotor; classify what is to be learned into: learning that emphasizes material for mental development (cognitive), learning that emphasizes emotion or feelings (affective), and learning that leads to a physical skill or ability (psychomotor). The three domains are subdivided into more finite levels.

LEARNING IN THE VOCATIONAL CONTEXT*

Claims Made for the Learning Process of Vocational Education

The philosophy of vocational education rests on the idea that the vocational curriculum differs in significant positive ways from the academic and general curricula. The vocational education program can be referred to typically as behavioristic, or an applied science. Not only does it focus upon work-related skills and values, but, proponents claim, its methodology and content motivate students to learn. This is especially noticeable for those students with a practical, concrete orientation. A concept such as calculation of an area, which a student may find difficult or meaningless in a chemistry or basic math classroom may be of more obvious value if incorporated in the actual real-world task of calculating the amount of paint needed for painting a room. The argument is that, both directly and indirectly, vocational coursework complements academic coursework--each type of education enhances the value of the other.

In a discussion of the noneconomic benefits of vocational education, Silberman (1980) sets up an "intrinsic perspective" that sees vocational education as a means to education in the broad sense of full human development. His paper makes explicit a number of claims for the process of vocational education that have been the subject of little rigorous investigation, but are often assumed to be true. Vocational education, Silberman says, offers

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*Several parts of this section have been directly adapted from Hotchkiss, Lawrence and Desy, Jeanne. Assessing the Contribution of Vocational Education to Basic Education in Secondary Schools, 1987.

"activities that are intrinsically meaningful and absorbing . . . [and emphasize] the playful aspects of work" (p. 43). He considers vocational education's opportunities for human development and personal satisfaction to be significant, and applauds the quality of the learning environment, the tangible product, and the pleasure of the process, which offer intrinsic motivation. Vocational education, Silberman claims, enables personal growth through a sense of competence, opportunities for creative expression, discipline and the integrity of good work, teamwork, and altruism.

The vocational classroom is often described as meeting different student learning needs than the academic classroom. The Unfinished Agenda (National Commission on Secondary Vocational Education 1984) refers to "vocational education's potential to respond to diverse learning styles" through a process that includes--

- immediate feedback;
- applied learning;
- cooperative, small-group activities;
- individualized learning;
- mastery learning;
- activities the student considers relevant;
- real-world experiences (especially through cooperative education);
- tactile and kinesthetic learning;
- opportunities to be creative; and
- productive tasks.

In these activities, the report claims, lie the real strength of

vocational education--"its ability to motivate students" (p.5).

Figure 1 lists some of the educational claims made for vocational education. This list highlights the specific desirable attitudes that research claims are learned in the vocational classroom. These attitudes, and other capabilities learned, are said to be fostered by the educational opportunities unique to the vocational classroom. As a glance at this list suggests, these opportunities derive from technical skills practice, the distinguishing feature of the vocational classroom.

Figure 1. Educational claims made for vocational education (excluding work-related outcomes).

Capabilities Learned by Students	Source of the Claim
Intellectual skills	Darcy 1980, McKinney and Fornash 1983, Pratzner and Russell 1984, Campbell and Pazano 1985
Skills for verbalizing information	Campbell and Pazano 1985
Cognitive strategies	Campbell and Pazano 1985
Motor skills	Unfinished Agenda
Attitudes	
Teamwork, cooperativeness	Silberman 1980 Unfinished Agenda
General motivation to learn	Pratzner and Russell 1984 McKinney and Fornash 1983
Sense of personal competence	Silberman 1980
Discipline	Silberman 1980
Educational Opportunities Provided Students	
Individualized learning	Unfinished Agenda
Mastery learning	Unfinished Agenda
Tactile and kinesthetic learning	Unfinished Agenda
Real-world performance	AVA 1981, Unfinished Agenda
Productive activities	Unfinished Agenda
Intrinsically meaningful (relevant) activities	Silberman 1980 Unfinished Agenda
Creative expression	Silberman 1980
Immediate feedback	Unfinished Agenda

Characteristics of the Vocational Classroom

In A Place Called School (Goodlad 1983) Goodlad describes his extensive examination of the classroom. Goodlad and his associates collected contextual data on over 1,000 elementary and secondary classrooms during the 1976-1978 school years. The overall data for secondary schools (which does include a proportional number of vocational classrooms) draws a familiar portrait of the high school classroom. Nearly 70 percent of total class time involves talk, and "teachers 'out-talk' students by a ratio of nearly three to one" (Sirotnik 1983). Most students, functioning usually as a total class, are involved in passive learning. Fewer than 5 percent work individually, fewer than 10 percent in small groups.

In a striking passage, Goodlad describes the general passivity of the classroom.

> Three categories of student activity marked by passivity--written work, listening, and preparing for assignments--dominate. . . . The chances are better than 50-50 that if you were to walk into any of the classrooms in our sample, you would see one of these three activities under way. . . . We saw a contrastingly low incidence of activities invoking active modes of learning. Except in the arts and vocational education, students were not very often called upon to build, draw, perform, role play, or make things. (Goodlad 1983, p. 105)

The vocational classroom offers practice, the "applied learning" of which The Unfinished Agenda speaks. It is also the distinguishing feature of the vocational classroom, lending it numerous characteristics of importance to learning, and affecting instructional style. Sirotnik's data (1981) show that psychomotor

practice occupies only 29.6 percent of the time in vocational classrooms, but only 4.1 percent of the time in academic classrooms and about 2.6 percent of basic skills (English and math) classrooms.

Weber et al. (1988) conducted a 2-year study of the processes that take place in secondary vocational classrooms. Data were collected in 120 schools and approximately 900 classrooms through questionnaires, interviews, and direct observation. This study showed an even higher relative proportion of vocational class time spent in the practice of technical skills--57 percent, with 29 percent spent on theory-related situations.

Classroom organization is also important to learning. For the great majority of all classroom time--75 percent--secondary students work as a total class. Students overall work individually less than 5 percent of the time and in small groups less than 10 percent of the time (Sirotnik 1983).

The vocational classroom shows a markedly different pattern. The secondary vocational students observed by Halasz, Behm and Fisch (1984) spent 80 percent of their time in class working individually or in small groups. Weber et al. (1988) found that vocational students worked in small groups 24 percent of the time, compared to 11 percent for nonvocational students. Further, vocational students worked on activities that provide a high degree of autonomy 56 percent of class time; nonvocational students did so only 11 percent of the time. Grouping has direct

implications for instructional method. Because vocational students spend so much time working individually, one-on-one instruction is far more common than lecture. Halasz, Behm, and Fisch (1984) found that secondary vocational teachers spent about 33 percent of their time providing one-on-one instruction and less than 3 percent lecturing.

A research comparison of academic and vocational classrooms shows two major differences between them. First, the vocational classroom is less auditory, which means there is substantially less learning through listening to words. In fact, the vocational classroom is less verbal altogether, giving less time to discussion, reading, and even test-taking than does the academic classroom. Second, in the vocational classroom considerably more time is devoted to practice of psychomotor skills. These findings support one of the key claims of vocational educators--that vocational classrooms offer a distinctive style and context. This emphasis on practice probably is the single most important feature of the vocational classroom, with implications of motivation and with special appeal to students with particular learning styles. These features will be discussed in a later section.
(Sirotnik 1981)

Teaching is one of the most challenging, yet one of the most internally satisfying professions available to the human being. Teaching is not only a profession where teachers teach students what they know, but they must also help students grow beyond their limits. Ultimately, the teacher must teach students beyond the teacher's limits. One area in which this is becoming more and

more necessary is in teaching the types of skills needed for a changing and uncertain future. The following section addresses this challenge.

Learning to Learn: Implications for Vocational Education

Employers more than ever before are seeking thinking/learning skills for more complex kinds of work and for greater flexibility in the face of accelerated change. Therefore, a needed emphasis in vocational programs is on teaching thinking skills explicitly for purposes of continued learning and applications in problem solving and decision making.

Workplace-oriented educators have long been aware that if they are to prepare students to function successfully in the work world, they must pay attention to what employers require of their employees. They know they must structure employer-required skills into the curriculum in a conscious way. In the past, this has meant 1) asking employers or advisory committees to help create and then validate occupational task lists for education and training curricula and 2) trying to keep up to date with new methods and laboratory equipment for performing those tasks. While this challenge to education continues in the face of accelerated technological change, other aspects of today's (and necessarily, tomorrow's) work world are becoming evident.

Employers are calling for employees with stronger academic foundations, especially in the basic disciplines of communications, mathematics, and science. What deserves some special emphasis is the consistent underlying message, supported by research, that isolated basic skills such as reading and

computation are not sufficient; employees must be able to use basic skills to make decisions and to solve problems. These requirements imply the use of thinking or reasoning skills.

Sticht and Mikulecky (1984) have compiled much research information from the field, and report:

> A good deal of recent research has examined basic skills in the workplace. This research includes work done in the military, and work examining wide ranges of occupations and workplaces...The findings in these studies indicate several trends. Most occupations require a high level of basic skills, although the applications of these skills may be diverse. The workplace requires not only the ability to read, write, and compute, but also the ability to use these skills in problem solving on the job...
>
> The nature of work in the United States and other industrialized countries is changing. As new jobs are created and old jobs disappear, new levels and types of basic skills for employment are also created. Occupations requiring little or no basic skills abilities are rapidly disappearing, while newly created occupations require workers to use reading and writing and computation at a fairly high level of skill in the solving of daily problems on the job. It appears likely that, in relation to job performance, it is considerably more important to apply basic skills in specific job situations than it is to demonstrate such skills on standardized tests. (pp. 4-7)

Behind these findings lies a redefinition of the nature of the work. Factories of the future may employ fewer workers to run automated assembly lines and to incorporate other sophisticated technological innovations. However, those workers, even at lower occupational levels, must be more highly skilled to recognize the problems, use their troubleshooting skills, and then design improvements. Therefore, it becomes evident that reasoning skills are and will continue to be critical.

The idea that school curricula tend not to include much practice in problem solving is borne out by statements such as the following:

> The most critical issue facing educators today is students' lack of adequate thinking skills for solving problems and making decisions. Although research has shown that nearly all students beyond the age of 12 should be able to reason at the formal operational level, fewer than 40% of high school graduates are able to demonstrate higher-level thinking skills. This is not due to low intelligence, but rather to students' inability to apply the higher-level skills and processes necessary for many curricula tasks. (Worsham and Stockton 1986, p. 7)

These references to higher-level skills and higher-level thinking should not be interpreted as relevant only for the intellectually elite. A case can be made that high-aptitude, high-achieving students are more likely to deduce such skills for themselves and that lower-aptitude students stand in greater need of direct instruction. As discussed by Jones, Palinscar, Ogle, and Carr,

> Levin (1987) argued that the reform movement has systematically neglected educationally disadvantaged students. Particularly damaging is the widespread practice of reserving cognitive instruction for teaching high-achieving students, thereby allotting basic skills instruction to low-achieving students. This practice deprives such students of the very thing they need most. (1987, p.xi)

Thus, reasoning skills must be built into the curriculum of all students, not just the talented and fortunate few. And it seems "reasonable" that a vocational context offering active application is a setting conducive both to teaching students the skills and to motivating them to learn the skills.

To forestall another possible misassumption from the reference to higher-order skills, it should be stated that recent research supports the idea that teaching and application of thinking skills must not be restricted to "advanced" studies. Indeed, thinking skills are necessarily involved in successful learning of the most elementary levels in all content areas (Resnick & Klopfer 1989). As Resnick elaborates,

> In fact, the term "higher order" skills is probably itself fundamentally misleading, for it suggests that another set of skills, presumably called "lower order," needs to come first. This assumption--that there is a sequence from lower level activities that do not require much independent thinking or judgment to higher level ones that do--colors much educational theory and practice. Implicitly at least, it justifies long years of drill on the "basics" before thinking and problem solving are demanded. Cognitive research on the nature of basic skills such as reading and mathematics provides a fundamental challenge to this assumption. Indeed, research suggests that failure to cultivate aspects of thinking such as those listed in our working definition of higher order skills may be the source of major learning difficulties even in elementary schools. (Resnick, 1989, p. 8)

Thinking Skills

What specifically is meant by "thinking skills?" The following mental activities are involved in the grouping associated with thinking:

- Finding structure and meaning in situations
- Analyzing tasks or problems
- Generating alternative ideas
- Monitoring one's own understanding
- Dealing with uncertainty.

Good teachers have always encouraged their students to think by the way they ask questions and lead discussions. However, education experts are now advocating explicit teaching of thinking. The vocational laboratory provides numerous opportunities for use of the teaching strategies thought to be effective in teaching thinking skills. These include:

- Designing and carrying out experiments in a structured way (What do you suppose would happen if we tried---?)
- Interacting in groups to discuss thought processes (How did you come up with the idea that---?)
- Generating questions and planning strategies (What approach should be used---?)
- Working through (not avoiding) errors (What do you suppose went wrong here?)
- Modeling sound reasoning (I started by asking myself---)

All these strategies can be and have been applied effectively in the vocational laboratory because of the problem solving and troubleshooting inherent in many vocational tasks.

It should be mentioned that this approach is highly consistent with the idea of trying to improve intelligence through special training. Those who advocate consideration of a number of different kinds of intelligence (e.g. Howard Gardner) might look to settings like the vocational lab as a suitable environment. Gardner, drawing on research from a wide range of disciplines, suggests seven ways that people can possess intelligence:

- Linguistic intelligence--sensitivity to the meaning and order of words and the varied uses of language.
- Logical-mathematical intelligence--the ability to handle long chains of reasoning and to recognize patterns and order in the world.

- Bodily-kinesthetic intelligence--a fine-tuned ability to use the body and to handle objects.
- Musical intelligence--sensitivity to pitch, melody, rhythm, and tone.
- Interpersonal intelligence--the ability to notice and make distinctions among others.
- Intrapersonal intelligence--access to one's own "feeling life." (Gardner 1983)

However, intelligence is only one student input to the learning process. Another critical factor is motivation, which will be discussed next.

CONCLUSION

In the United States of America scholars have intensively studied the process of learning in vocational education for the past fifty years. Prior to this time, educational research focused upon learning in general; these studies were subsequently adapted for application to vocational education.

Clearly, much still remains to be discovered about the process of learning in vocational education. In fact, as we move ahead to the twenty-first century, both the context of the vocational education and the process of learning will be primary areas of researcher attention.

This paper was provided to help the reader gain a sense of the process of learning in vocational education in the USA. Volumes of material have been published about each separate topic which the authors address. Therefore, indepth exploration of any of these topics will require the reader to return to original documents and additional references.

The authors have offered this, the first paper on the Learning Process in Vocational Education, as an initial step in the process of what is hoped to be an extremely beneficial exchange of information.

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